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Educating America about the Value of Medical Simulation

Advanced Initiatives in Medical Simulation

Simulation in Health Care: A Model for Improving Patient Safety and Ensuring Quality

Building a National Agenda

For Simulation-Based Medical Education

3rd Annual Advanced Initiatives in Medical Simulation Conference

Center for Telehealth & E-Health Law, formerly the Center for Telemedicine Law
Advanced Initiatives in Medical Simulation

June 2006



Educating America about the Value of Medical Simulation

A d v a n c e d I n i t i a t i v e s i n M e d i c a l S i m u l a t i o n

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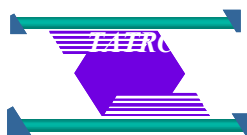
Building a National Agenda

For Simulation-Based Medical Education

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Advanced Initiatives in Medical Simulation

Medical Simulation's Role in Promoting Patient Safety

**Forest Glen Annex, Walter Reed Army Medical Center, Silver Spring, MD 20910
May 16, 2006**

Welcome and Acknowledgement

*Steven Dawson, MD, Center for the Integration of Medicine & Innovative Technology (CIMIT),
Massachusetts General Hospital, Founding Advanced Initiatives in Medical Simulation*

(AIMS) Member, Chair, AIMS

*Col. Mark Bowyer, MD, Uniformed Service University of the Health Sciences (USUHS), AIMS
Planning Committee*

*Gerald Moses, PhD, Telemedicine and Advanced Technology Resource Center (TATRC), U.S.
Army, AIMS Planning Committee*

*Jackie Eder-Van Hook, MS, Executive Director, Center for Telehealth & E-Health Law (CTeL)
and Advanced Initiatives in Medical Simulation, AIMS Planning Committee*

Steven Dawson, MD, opened the meeting by reporting that Advanced Initiatives in Medical Simulation (AIMS) has grown significantly in its first two years, and attendance at the current meeting was 40% higher than in the previous year. The organization now has a vibrant and integral Industry Council, as well as strong support from the U.S. Army's Telemedicine and Advanced Technology Resource Center (TATRC), the Center for the Integration of Medicine & Innovative Technology (CIMIT) at Massachusetts General Hospital, Stanford University and many others.

Dr. Dawson explained that AIMS provides a national voice for medical simulation – it educates and articulates the value of simulation to a broader national audience and convenes external stakeholders in an effort to find or create champions for medical simulation. The Society for Simulation in Healthcare (SSH), formerly the Society of Medical Simulation, is an academic society focused on education, assessment, and research, and sponsors a journal devoted to medical simulation. On May 17, 2006, AIMS will host a one-day exhibition on Capitol Hill to demonstrate the breadth and depth of medical simulation and raise its national visibility, a major goal of AIMS.

Col. Mark Bowyer, MD, directs the National Capital Simulation Center at the Uniformed Service University of the Health Sciences (USUHS), a host of the AIMS conference. He stated that although AIMS is only three years old, it has already accomplished a great deal. AIMS has hosted three annual conferences, which have helped further build the medical simulation community; it has hosted three exhibitions on Capitol Hill resulting in interest from 134 Members of Congress, up from one Congressional sponsor in the first year; and, introduced or reintroduced medical simulation to staff at the Agency for Healthcare Research and Quality (AHRQ), which announced the availability of \$2.4 million in medical simulation research grants.

Gerry Moses, PhD, explained that TATRC has been the leading funder of medical simulation and training research for many years. TATRC's research portfolio focuses on the military's need to train more than 100,000 medical personnel each year. The old "see one, do one, teach one" model is not effective for a mission of this scope, so the military has embraced medical simulation for training. Over the past few years, TATRC has invested \$80 million in more than 100 research projects on medical simulation for training. TATRC is a relatively small research agency, therefore, it is necessary to raise the issue of medical simulation for training to a national level to leverage the funding that has already been expended on this research and make a difference in health care and health care training.

Dr. Moses thanked Jackie Eder-Van Hook, MS, for her excellent leadership of both AIMS and CTeL. He also expressed appreciation to the AIMS Industry Council, which has provided support and contributed to AIMS's growth.

Ms. Eder-Van Hook invited all conference attendees to participate in the 3rd Annual AIMS Exhibition to be held on Capitol Hill on May 17, 2006.

Medical Simulation's Role in Promoting Patient Safety

Carolyn Clancy, MD, Director, Agency for Healthcare Research and Quality (AHRQ)

James Battles, PhD, Center for Quality Improvement and Patient Safety, AHRQ

In her videotaped remarks, Carolyn Clancy, MD, explained that AHRQ's mission is to improve the quality, safety, efficiency, and effectiveness of health care for all Americans. Thanks to the Agency's many partners, it is making significant progress in improving quality, patient safety, the use of health information technology (HIT), evidence-based medicine, performance measurement, and consumer-focused care.

Since 2001, AHRQ has funded more than 221 projects in patient safety and HIT and it recently awarded more than \$8 million to 15 partnerships to implement patient safety research findings. The Agency has also funded an extensive number of projects to speed up the implementation of HIT. AHRQ supports a national HIT resource center to put research findings into the hands of those who provide patient care every day.

AHRQ believes that the use of HIT, including medical simulation, can have a dramatic impact on the quality and safety of care that patients receive. AHRQ's investments in the past few years are allowing the agency to make tools available and resources for providers and policymakers to improve patient safety. AHRQ's investments also have shown how medical simulation can be one of the most powerful tools in the patient safety arsenal.

AHRQ recently announced \$2.4 million in grant funding for 8 to 10 new projects to evaluate the impact of simulation and related strategies on improving the quality and safety of care. The Agency has already received more than 200 letters of intent for this initiative.

Today's patients should not be put at risk to help train the practitioners of tomorrow. Models and other techniques are needed to ensure that patients receive the best care from practitioners

the first time. Through AHRQ's studies of simulation, HIT, and the safety and quality of care, it will be possible to achieve these goals.

James Battles, PhD, explained that AHRQ is the lead agency in the Department of Health and Human Services for patient safety. Studies show that to learn how to perform certain invasive surgical procedures, providers must conduct the procedures 150 to 200 times. Evidence indicates that this learning curve can be shortened through simulation.

Discussion

Dan Raemer, PhD, asked whether AHRQ might be able to provide additional funding for medical simulation research in the future. Dr. Battles explained that AHRQ's limited budget precludes funding all of the excellent projects submitted, but the Agency works diligently to collaborate with other funding sources whenever possible. In reality, AHRQ can only provide support within its budget, even though it would like to expand its support for medical simulation.

Dr. Dawson suggested that medical simulation supporters engage policymakers in order to secure additional funding for AHRQ.

Dr. Battles noted that accrediting organizations are demonstrating an interest in simulation. As this begins to increase pressure on educational institutions, this will help make the case for additional funding for this research.

Col. Bowyer asked whether AHRQ might play a role in coordinating the organized medicine and board representatives who are showing an interest in this issue. This could provide some visibility for the work being done with simulation to improve patient safety. Dr. Battles replied that the idea has merit for further discussion. Dale Alverson, MD, of the University of New Mexico suggested bringing together government agencies, academics, and industry representatives with an interest in medical simulation to identify ways to share resources and move the field forward.

David Gaba, MD, of Stanford University, predicted that simulation would not be embedded into the fabric of health care today or next year; rather, it will take many years. Dr. Battles thought that federal agencies are unlikely to provide long-term support for simulation, so this is a challenge for institutions and industry. If a company sells only a few simulators, they will be very expensive. Areas in which large-scale deployment is possible must be identified and targeted efforts applied there.

J. Harvey Magee of TATRC, offered to initiate discussions on how TATRC and AHRQ might collaborate to ensure that opportunities are leveraged and to prevent duplication. Dr. Battles expressed an interest in collaborating with TATRC and others.

Matthew Hess of Central Wyoming College said that small, rural institutions have a strong need for medical simulation and might be able to provide leadership in the search for funding.

Michael Olympio, MD, of Wake Forest University, noted that many people are requesting validation that simulation is an effective teaching tool, often because they are fearful of simulation and need to be convinced that it will be beneficial to their practices. Dr. Battles said that it is difficult to identify appropriate outcome measures, but this will be necessary to show that simulation makes a difference.

Aalpen Patel, MD, of University of Pennsylvania, School of Medicine, suggested incorporating existing technology while continuing validation efforts. Once the validation findings are available, they can be used to improve the technology. Both implementation and validation would need to be conducted simultaneously.

Gerry Higgins, PhD, of the Laerdal Corporation, noted that simulation is already being used in nursing, emergency medical services, and other allied health professions. Dr. Battles agreed that in some areas, the argument has already been won.

Chandice Covington, PhD, stated that a great deal of simulation technology is already available, but many people have never heard of it. Dr. Battles agreed that researchers tend to focus on publishing their findings and not on disseminating them into practice. Putting research into practice is a fundamental and long-held goal for AHRQ.

Ms. Eder-Van Hook asked Dr. Battles if he would agree that there was a prominent role for members of the simulation community to serve on study review committees. He agreed enthusiastically, stating medical simulation would greatly benefit from experts participating on study review committees, as the field is still too new to the broader medical community.

Ms. Eder-Van Hook further commented that AIMS has done outreach with a number of agencies, including AHRQ, the Indian Health Service, and the Institute of Medicine as well as health professions beyond medicine, such as nursing schools. She encourages the community to continue its outreach efforts more broadly.

The Intersection of Research and Practical Applications at the National Institutes of Health

John W. Haller, PhD, National Institute of Biomedical Imaging and Bioengineering

John Haller, PhD, reported that the National Institute of Biomedical Imaging and Bioengineering (NIBIB) was founded in 2000 and is the newest institute at the National Institutes of Health (NIH). NIBIB is a relatively small institute, with an annual budget of approximately \$300 million, which is comparable in size to the AHRQ budget. Its mission is to improve human health by leading the development and acceleration of the application of biomedical technologies. NIBIB is committed to integrating the physical and engineering sciences with the life sciences to advance basic research and medical care.

NIBIB has several programs in biomedical imaging and biomedical engineering including, for example, a project entitled, *Haptics for Robot-Assisted Minimally Invasive Surgery*. The goal of this project is to provide haptic feedback (synthetic force and/or tactile sensations) to a surgeon via telemanipulator to improve safety and efficacy of surgical robots. Information on the funding opportunities is available on NIBIB's website at www.nibib.nih.gov. The *NIH Guide for Grants and Contracts* is also available online at grants1.nih.gov/grants/guide/index.html.

NIBIB leads the Trans-NIH Funding Opportunities in Bioengineering Research (BECON), a consortium of NIH institutes that offers exploratory/developmental bioengineering research grants, bioengineering research grants and partnerships, training grants, and small business and technology transfer awards. The Innovations in Biomedical Computational Science program may be particularly relevant to the medical simulation field, e.g., (Small Business Innovation Research [SBIR], PAR-06-088; Small Business Technology Transfer [STTR], PAR-06-089).

Although NIBIB and the other NIH institutes invite applications for specific initiatives, investigators can submit applications without responding to a call for applications. In fact, most of the applications submitted to NIH are unsolicited. NIH wants great ideas from investigators, but it is a good idea to talk about these ideas with program directors before submitting them.

Several study sections review the applications submitted to NIH. Three that may be relevant to medical simulation are:

- Modeling and Analysis of Biological Systems study section, which reviews applications to develop modeling/enabling technologies for understanding the complexity of biological systems.
- Biodata Management and Analysis study section, which reviews applications to develop technologies for the management and analysis of basic biological data
- Surgical Sciences, Biomedical Imaging, and Bioengineering study section, which reviews applications for research on a variety of areas at the interface between physical science or engineering and biomedical or clinical research.

Medical simulation applications are not always viewed favorably by study sections, mainly due to relevance and validation issues.

To support innovative ideas, NIBIB has a new investigator policy to fund investigators who have not previously applied to NIH for funding and who have score within five (5) percentile points from the “payline” (that is the point at which there is interest in funding and funding exists for those applications above a certain score.) Another program supports high-risk/high-impact research that typically does not do well in study section review. In addition, NIBIB offers several research, training, fellowship, and career development awards.

Discussion

Mr. Magee of TATRC offered to collaborate with NIBIB to prevent duplication.

In response to a question from Bob Waters, JD, of Gardner Carton & Douglas, LLP, Dr. Haller explained that investigators could generate a list of simulation projects funded by NIH on the Computer Retrieval of Information on Scientific Projects (CRISP), available at <http://crisp.cit.nih.gov>.

Dr. Alverson asked how to address relevance and validation in simulation applications to NIBIB. Dr. Haller said that reviewers decide whether an application has relevance and significance. In general, NIBIB encourages engineers who are developing technologies to work with clinicians to identify their needs and ensure that the devices meet important needs.

Ms. Eder-Van Hook asked Dr. Haller if he agreed that there was a prominent role for members of the simulation community to serve as members of study review committees. Dr. Haller wholeheartedly agreed, concurring with Dr. Battles' assessment that simulation is too new to the broader medical community that additional expertise is needed on study review.

Organized Medicine's Perspectives on Simulation

Robert S. Rhodes, MD, American Board of Surgery

Stephen G. Clyman, MD, National Board of Medical Examiners

Robert Rhodes, MD, explained that the American Board of Surgery (ABS) sets the standards for qualifications for general surgeons, pediatric and vascular surgeons, and surgical critical care. All of ABS's income comes from examination fees.

Dr. Rhodes distinguished the components involved in ensuring physician and surgeon quality. Board certification is geared to individuals. In the United States, certification is voluntary. In contrast, licensure is state-mandated. Accreditation pertains to institutions that comply with certain set standards. Finally, privileges are conferred on individuals through hospitals for admitting or performing certain procedures.

To be certified by ABS, a surgeon must complete undergraduate medical and residency education at accredited institutions and pass multiple-choice and oral exams. Current certification, therefore, is based on an assessment of what candidates know when given certain theoretical surgical situations.

Simulation offers an opportunity for improvement in safe settings, where students will do no harm. Medical simulation can make it possible to shift the focus in health care from certification to a demonstration of skills.

ABS believes that simulation will replace the “see one, do one, teach one” paradigm with deliberate, perfect practice. Although simulation cannot replace experience with patients, it can speed up the student’s preparation for those experiences. A new paradigm is needed in which simulation is a formal part of the curriculum and students do not advance until they have mastered certain requisite areas.

Simulation offers great promise for improving quality and safety. For example, during a provider’s career, many technologies are likely to emerge that will require training so that they can be used safely and effectively. Simulation also plays an important role in rehearsing infrequent procedures, which, when perfected, can improve outcomes and patient safety.

After determining what *should* be assessed when deciding whether a simulator should be used for training, what measurements are needed should be identified, and only then can a simulator/simulation be created.

Potential barriers to the implementation of simulation include the need for a business case to show that simulation may reduce the costs of health care. If simulation does not reduce costs, then the cost/quality trade-off must be articulated.

Simulation must not be laid over the existing residency education paradigm. Instead, residency education must be rethought and the goals and objectives that can be met through simulation must be embedded into the curriculum. This will produce a better product at the end of residency training. Once residents are trained using simulation, they are likely to make it part of their ongoing medical careers.

Stephen Clyman, MD, listed several mechanisms to ensure the quality of physicians, including admissions testing, U.S. medical licensing exams, medical school graduating requirements, residency requirements, residency completion, and maintenance of specialty board certification. The National Board of Medical Examiners (NBME) assesses students’ understanding of concepts basic to the practice of medicine, ability to apply their knowledge and skills to clinical sciences, and ability to apply the knowledge and understanding that are essential to unsupervised practice.

NBME currently uses multiple-choice questions to assess students’ knowledge base. To determine how candidates apply what they know in realistic environments, NBME provides computer-based case simulations. Candidates read about a case and indicate what they would do; the direction of the case depends on the candidate’s responses. Finally, students have encounters with trained patient simulators.

The theoretical underpinning for the use of simulation in instruction is well established as empirical evidence shows that the development of proficiency requires experience. When people learn something in an environment that resembles the environment in which they practice, they are more likely to remember what they learned.

The drivers of simulation include the changing physician role, which now involves informatics, teams, systems, and telemedicine. Other drivers are professional mandates from groups, such as the Accreditation Council for Graduate Medical Education, societal expectations from consumers for higher quality and lower costs, and new technologies, including electronic health records.

Educators are not using simulation very effectively, and most of the simulations they do use are of low fidelity. High-fidelity simulations should be used to provide trainees with experience and to ensure that practicing physicians continue to acquire new skills.

Discussion

Col. Bowyer reported that simulation is being used in Israel to determine which candidates to admit to medical school. Dr. Clyman said that NBME is interested in tools that can be used at the entry point to admit those students with the greatest likelihood of completing the program. These tools could be used to assess interpersonal skills and professionalism. Dr. Rhodes supported the need for this type of assessment, but pointed out that the skills required to do well in medical training are not necessarily the same as those needed to become an independent surgeon. It would be difficult to convince trainees who are doing well that they do not have the skills required to become surgeons. In addition, the Israeli program is being conducted in a small geographic area with a defined population; implementing this program in the United States would be more challenging.

Dr. Rhodes reported that ABS has just hired Dr. Richard “Dick” Bell, who will spend at least half of his time on curriculum development with other organizations, such as the American Cancer Society and the American Surgical Association. His goal is to identify an explicit set of objectives and ways to achieve those objectives.

Mr. Magee asked how long it might take to adopt a perfect simulator, if one existed, and incorporate it into training. Dr. Rhodes said that this could take decades, not because of technology issues, but because of the health care system culture. Ideally, patients would demand that simulation-based training for their physicians and use it as a litmus test for selecting the best-trained physicians. Unfortunately, very few patients use report card information. The drivers for incorporating simulators go beyond software and hardware to getting consumers to demand that their physicians be trained on this type of equipment and demonstrate this type of proficiency.

Richard Kyle of USUHS, suggested abandoning the “car wash” model of clinical education, in which all students go through the system at the same rate and all are certified at the end. Instead, students should be required to demonstrate a high level of performance rather than simply that they have knowledge before proceeding to the next step. Progress would be based on performance rather than time spent, which is a radical departure from the current system.

Dr. Clyman noted that the educational and accreditation process takes years, and several components of the process have increased further the amount of time necessary to complete the education and accrediting process. It may not make sense to have residencies take place in a second institution, for example. A new model is needed in which students proceed at an individual pace. It is not clear, however, how to implement such a model. Dr. Rhodes added that coordination is needed to identify what students are supposed to know and what they must do to be able to cross the next threshold. Medicine needs to attach objectives to each specialty and each stage in the continuum from novice to beginner, proficient, master, and expert.

William Dunn, MD, of the Mayo Multidisciplinary Simulation Center, expressed disappointment that it will take a decade or more to add an experiential component to the surgical board examination, given what is happening in technology and the levels of interest and enthusiasm in surgical circles.

Dr. Rhodes explained that traditionally, the board has required residents to have experience with a specific number of cases and to have held chief resident responsibility. When a candidate's responses show that he or she has no experience, the board will not certify this individual.

Dr. Rhodes commented that simulation lets people demonstrate their proficiency, which can help the board with certification and provides an objective measure. The simulators used in surgery often provide convincing data that experts have markedly less wasted motion than less experienced individuals. The skills they have can be identified and become the standard, so less experienced people can practice until they reach those standards. Currently, no such metric exists.

A participant said that skills such as communication and professional behavior are as important to being a good physician as technical skills. Dr. Rhodes agreed, noting that teamwork, team training, and communication are increasingly recognized as important.

Colleen M. Kigin, DPT of Partners HealthCare System, suggested that the boards consider measuring outcomes of episodes of care rather than interventions used. Dr. Clyman agreed. He pointed out that it is necessary to examine the aggregate effects of both individual and team performance on outcomes.

Laura Provan, of the American College of Cardiology, reported that one medical malpractice insurance company asks at renewal whether the physician has had simulation training. She wondered whether others have similar experiences and what the impact might be on the acceptance of simulation training. Dr. Rhodes noted that under Dr.

Gaba's leadership, the anesthesia field has improved practice, which has led to reductions in malpractice insurance premiums. Dr. Dawson noted that in Massachusetts, anesthesiologists are asked about simulation training when they renew their insurance policies.

Rob Mazzoli, MD, of the American Academy of Ophthalmology, said that if residents eventually are expected to train so that they can perform at an expert level of proficiency, the standards for proficiency should be tied to the skills of experts across the country. Dr. Rhodes agreed that the expert level should be a national criterion.

Dr. Rhodes added that given the expense of simulators, it might be necessary to establish regional centers for simulators. It might also be necessary to develop portable simulators that residents can use outside their normal work hours because of the increasing restrictions on residents' work hours.

Don Moorman, MD, of Beth Israel Deaconess Medical Center, asked about the use of simulation in the context of deteriorating practice skills. Dr. Rhodes explained that the board wrestles with the issue of rehabilitation and retraining, which need to be offered in a non-judgmental and confidential way so that no stigma is attached. Evidence shows that knowledge degrades over time, and some studies have shown that older physicians do not provide the same level of care as younger physicians.

Dr. Covington wondered about the future of technology, since some of the models used in nursing seem out of date. Col. Bowyer said that the biggest challenge for advancing the technology used in simulation has been to obtain sufficient funding. Aviation provides a superb level of fidelity, but the industry has spent billions on the technology, while medical simulation has received less than \$500 million from all sources. Major disparities exist between the technology used in simulation and that available in gaming and other fields. If more resources were invested, the dividends would be significant.

However, Dr. Rhodes emphasized the importance of ensuring that the technology does not outstrip what people are supposed to learn from it. Dr. Gaba added that simulation is a technique, not a technology. Virtual reality does some things well, but sometimes people need to be with other people, not machines. Even if the money were available, it would not be possible to design and build humans with instruction manuals.

Activating the Medical Simulation Community

Jackie Eder-Van Hook, MS, Executive Director, CTeL and AIMS, AIMS Planning Committee
Robert J. Waters, JD, Gardner Carton & Douglas LLP, AIMS Planning Committee

Ms. Eder-Van Hook stated that at the first AIMS meeting in 2004, participants agreed that underlying theme of improving patient safety was the best way in which to talk about medical simulation to others. At that time, AIMS wanted to build the simulation community and it has now developed an extensive list of people interested in medical simulation. AIMS is continuing to define the simulation message via conversations with colleagues throughout the country. It is continuing to identify and foster champions, including the 134 Members of Congress who agreed to serve as honorary co-hosts for the 2006 AIMS exhibition and others. The organization is continuing to educate and build enthusiasm about the benefits of medical simulation.

Mr. Waters discussed some of the assets of medical simulation. First, the technology sells itself and once people hear about it, they become interested. Dr. Clancy and AHRQ developed a grant program providing \$2.4 million in funding after a single visit to a simulation center. She could see the value of medical simulation. She also could see how simulation could positively change clinical practice and patient outcomes. In addition, the concept of simulation is intuitively logical and people understand that by improving proficiency in high-risk procedures, physicians can do their jobs better. They quickly understand that the more physicians practice a technique, the more proficient they will be. Another asset of medical simulation is its huge potential societal benefits. The Institute of Medicine's *To Err Is Human* report said that from 50,000 to 100,000 deaths occur each year due to medical errors. Simulation offers one of the few options available to reduce this error rate.

Simulation also has some liabilities. For example, it has a limited customer base of medical and allied health professional schools. Furthermore, the technology is expensive and many others are competing for the funds that the medical simulation community is seeking--pointing to the need for community effort and a common plan.

Mr. Waters listed some of the major objectives that our society has pursued, such as putting a man on the moon and mapping the human genome. These goals were specific and measurable and achieving them led to huge benefits. Mr. Waters believes that medical simulation belongs in this list. If the goals in medical simulation were met, this would have many spin-off benefits for society that are not related to medicine, but specific and realistic goals must be established.

To activate the medical simulation community, Mr. Waters proposed the following approaches:

- Use a "big tent" approach. Everyone who is interested in medical simulation must be included, regardless of how each defines medical simulation. Each brings different assets and a role can be found for everyone.
- Develop a plan that can be adjusted as progress is made.
- Identify champions, including public policymakers and medical society leaders.
- Take action to get people excited about medical simulation. People may not want to help at the beginning, but if an activity is started and they are invited to join, they will want to be part of it. Someone has to take the initiative and disturb the status quo.
- Provide interim payoffs, which are always needed for complex endeavors to show that progress has been made.
- Identify spin-offs, because the tools that will be developed will have benefits that reach beyond those that are expected.
- Adapt to needs and opportunities. For example, homeland security and avian flu are current federal priorities, and funds might be available for medical simulation within these programs.

The government's role is to provide financial support for this difficult research, whose results are not close to being commercialized, offer support for purchasing simulation technology to medical and health sciences schools, and establish resource centers. These three categories of activity would link government, universities, and industry. Businesses have an important role to play in advancing medical simulation, but they need increased opportunities to make a profit, if

they are to survive. If businesses can reduce the cost of medical simulation, this will reduce the cost of health care. The role of academic and professional groups is to improve training, reduce errors, manage risk, and improve proficiency.

Other objectives are to raise the visibility of simulation training and manage risk by using simulation. If the Food and Drug Administration (FDA) requires providers to use simulation before using certain devices and if the Centers for Medicare and Medicaid Services will only reimburse for providers with simulation experience, everyone will start using simulation. It is critical to identify the right levers, but there are plenty of ways to move forward.

Mr. Waters and Ms. Eder-Van Hook will continue to work with the meeting attendees and other leaders in the field to develop an appropriate roadmap, including strategies and tactics, to move the field forward. Through partnerships, it is possible to move the medical simulation field ahead more rapidly.

Discussion

Jeffrey Cooper, PhD, of the Center for Medical Simulation, asked about engaging patient advocates in medical simulation. Mr. Waters said that patient safety advocates are essential partners and will drive the field forward even more than medical professionals. It is critical to find the right way to engage advocacy organizations. Dr. Cooper noted that a patient advocacy movement is growing among those who personally have experienced a medical error. Patients are beginning to demand safer care, and they can be strong advocates. Mr. Waters said that they need to be educated about the value and use of simulation technologies. Dr. Cooper suggested that AIMS establish relationships with Consumers Advancing Patient Safety, Medically Induced Trauma Support Service, Patients United for Limiting Substandards and Errors known as PULSE, and the National Patient Safety Foundation. Betsy Hunt, MD, MPH, of Johns Hopkins University, has had more success in obtaining philanthropic support when members of the public became interested after experiencing adverse events.

Dr. Alverson wondered how to support efforts to move the simulation effort forward. Mr. Waters suggested that those who are interested get their friends and colleagues involved in the community.

Ms. Eder-Van Hook said that both AIMS and CTel need not only financial support, but also more people to become involved. She urged participants to bring key leaders in their local communities to their simulation centers and to become involved in AIMS and SSH. Mr. Waters noted that the AIMS website at www.medsim.org would post some steps that can be taken to advance medical simulation. Dr. Dawson said that many ways to help are available and all types of assistance are welcome. A possibility is to join AIMS as a founding organization.

Col. Bowyer noted that although applications for medical simulation research are often not funded, because they lack relevance, nothing could be more relevant than improving patient safety. He wondered how to communicate this message. Mr. Waters said that this would require increased participation at NIH by simulation supporters.

Michael Seropian, MD, of Oregon Health & Science University, pointed out that purchasers of simulation technology often focus more on the “toy” than on the needed infrastructure. Too many people buy now and think later. If technologies are brought in without information on how to implement them effectively, the effort will fail. Mr. Waters agreed that many of the units that were distributed early on were not used effectively and this did not help the field. A resource center providing information on what works would be very valuable. The focus should not be on pushing out the latest technologies because the best technologies are sometimes also the simplest.

Dr. Moses thanked Mr. Waters and expressed his hope that this meeting and the AIMS efforts generally would lead to the development of a roadmap for medical simulation.

Society for Simulation in Healthcare Update

Dan Raemer, PhD, Partners HealthCare; Chair, Society for Simulation in Healthcare, AIMS Planning Committee

David Gaba, MD, Stanford University; Editor, Simulation in Healthcare; Founding AIMS Member, AIMS Member Board of Directors

Dr. Raemer explained that the Society for Medical Simulation changed its name to the Society for Simulation in Healthcare (SSH) to represent a broader outlook and spectrum of members who are medical, nursing, and allied health professionals. SSH is an international, multidisciplinary, academic society focused on education, assessment, and research whose mission is to foster improvement in health care through simulation. SSH takes a very broad view of simulation and includes standardized patients and virtual patients, mathematical simulations, and surgical and procedural simulators.

AIMS serves in a complementary role and provides a national voice for medical simulation. AIMS’ mission is to educate public and private policymakers, articulate the value of simulation to a broad national audience, and convene external stakeholders in an effort to find or create champions for medical simulation.

At last year’s AIMS meeting, SSH had just incorporated. It has made a great deal of progress since that time. SSH recently elected new board members and officers to include a broad range of specialties within the organization’s leadership. The organization is financially sound with nearly 1,000 members. Recently, it launched the *Journal of Simulation in Healthcare* to which Dr. Raemer urged the submission of manuscripts. Further, Dr. Raemer invited all meeting attendees to join SSH, its committees, and attend the 2007 society meeting in Orlando on January 14-17, 2007.

Dr. Gaba is Editor in Chief of *Simulation in Healthcare: the Journal of Simulation in Healthcare*. Its publisher is Lippincott, Williams & Wilkins, a sponsor of this conference. This multidisciplinary quarterly journal is dedicated solely to simulation in health care. The first issue was published in January 2006. The editorial board includes 45 individuals representing a broad range of disciplines, and the manager is Beverlee Anderson, who is also the executive director of SSH.

The journal publishes several different types of articles. Technical reports are particularly important in this field because the techniques and technologies that are being used must be described so that others can make advances based on that work. The journal also publishes papers on the economics or health policy of simulation. Its concepts and commentaries address the theory or conceptual underpinning of issues in the field, rather than the technical nuts and bolts of empirical research.

All members of SSH receive the journal, which provides income for SSH through advertising, library subscriptions, and other sources. The journal's website is part of the SSH website at www.ssih.org and includes instructions for the submission of articles.

Once the journal has published a year's worth of issues, it will be eligible to apply for indexing through *Index Medicus*. The journal's application for indexing, therefore, will be submitted in the first quarter of 2007, but it will take up to a year to obtain a decision. The journal is currently indexed on Ovid, Lippincott's indexing system, which is available at many medical libraries.

To increase the journal's impact factor, researchers need to reference articles in the journal when they submit manuscripts to other journals.

The journal is an important vehicle for supporting the AIMS agenda, because it offers evidence of the credibility of simulation and addresses both empirical data and theory. The journal will provide an important forum for disseminating ideas and research results on simulation and health policy.

Risk Management Perspective

Luke Sato, MD, Chief Medical Officer and Vice President, CRICO/Risk Management Foundation of the Harvard Medical Institutions, Inc.

Dr. Luke Sato, explained that CRICO/Risk Management Foundation (CRICO/RMF) provides malpractice insurance for the Harvard medical system. The company is owned by its insureds. Its annual premiums total approximately \$120 million.

According to company data, from 1990 to 1999, 67% of claims were related to diagnosis, surgery, obstetrics, or medication, and these claims constituted 91% of the company's losses. Ensuring that technical skills are obtained before live procedures are performed has reduced malpractice claims. A review of CRICO/RMF's data claim, between 2000 and 2005, showed that the number of claims and the amount of losses decreased after simulation training was put into place.

Many medical malpractice problems arise when patients move between different parts of the health care system due to lack of communication and loss of information. Often, no one is accountable for overseeing a patient's care as the patient moves through the system. By far, the most common reason why patients sue their providers is that their expectations were unmet. In other cases, people sue because they want more information or they want their hospital and/or physicians to understand what they experienced. Patients also sue because of unrealistic

expectations of medical technology, difficulties between patient and provider, and/or the encouragement of a friend or family member to file suit.

Malpractice cases often represent a conglomerate of process failures. For our patient's sake, we must ensure that someone "owns" the patient's care; that is, takes responsibility for the patient, such as communicating to the caregivers about the patient's condition, monitoring high-risk patients, managing/flagging abnormal test and lab results, and updating patient family history and co-morbidities are crucial for the safety and well-being of the patient. This ownership reduces the incidence of malpractice claims.

CRICO/RMF is working with the Harvard Business School to develop a conceptual model of layered processes in health care delivery. In this model, the physician interacts with the patient at the sharp end of an upside-down pyramid, where many diagnostic and technical processes occur. To care for their patients, providers rely on clinical support processes that provide information, such as radiology and laboratory systems and office reminders. The next layer consists of business processes, such as scheduling, admitting, and registration, that are required to run a hospital, office, or clinic. The top two layers consist of culture/organizational environment and leadership. From 1976 to 2005, approximately half of CRICO/RMF's professional liability malpractice cases were attributable to individual patient/clinician interaction issues and the remaining 51% involved systems-based or process failures.

In response to these findings, CRICO/RMF decided to provide leadership training in business processes and management skills. Too often, clinicians are given managerial authority with little or no management experience. CRICO/RMF plans to collaborate with the Harvard Business School to provide training to leaders on how to run an organization. This training is being pilot tested with two hospitals and when the curriculum is developed further, it will be applied throughout the Harvard hospital system.

**Harvard's risk management foundation reduced
malpractice premiums by 25% for anesthesiologists
who had undergone simulator training**

Half of CRICO/RMF's cases pertain to training issues, which the company believes could be mitigated using medical simulation and team training. In the late 1980s, malpractice claims in anesthesiology were high. New technologies introduced in the late 1990s offered ways to eliminate some safety issues, and collaborations among Harvard hospitals resulted in the identification of safe practices. As a result, the number of claims stabilized. In 2001, anesthesiology chiefs in the Harvard system began requiring all residents and anesthesiologists to undergo simulation training to qualify for a \$500 premium reduction. As a result, almost 95% of anesthesiologists and anesthesiology residents are receiving simulator training. The most recent actuary report found that the number of malpractice claims decreased due to medical simulation training, allowing **CRICO/RMF to reduce premiums by nearly 15% for anesthesiologists who had not received simulator training and a reduction of 25% for anesthesiologists with simulator training.**

The amount of payouts and malpractice claims was also high in obstetrics, so CRICO/RMF worked with the obstetrics chiefs to develop an incentive program. To qualify for a three-year 10% reduction in annual fees, currently around \$55,000, obstetricians had to undergo didactic or simulator-based team training, complete a safety climate survey, take an obstetrics clinical practice guidelines test, take online continuing medical education (CME) courses on electronic fetal monitoring and shoulder dystocia, and complete a physician satisfaction survey. In years two and three, obstetricians were required to complete team training refreshers, online CME courses, an obstetrics guidelines test, and obstetrics safety drills. The obstetrics team training has produced a significant improvement of almost 50% for high-risk births.

Dr. Sato urged others to begin using simulation in team training, because for CRICO/RMF, it has had a major impact on claims and consequently premiums in both anesthesiology and obstetrics. The company is now working with task forces to incorporate simulation and team training as tools to achieve risk management objectives in emergency and surgery departments, elsewhere in the Harvard medical system.

Discussion

Dr. Alverson wondered why other malpractice insurance companies are not jumping on this bandwagon. Dr. Sato explained that CRICO/RMF has a unique relationship with the Harvard hospitals. For example, the CEOs of each hospital sit on the company's board, so leadership is well aware of the effectiveness of certain tools to change physician behavior. Other insurance and malpractice companies tend to have chief financial officers or attorneys on their boards and it can be difficult to convince them to take the required leap of faith.

Chafic Kazoun of B-Line Medical asked whether institutions should join forces to build large simulation centers close to the operational standards of an actual hospital, or whether smaller stand-alone simulation centers would be better. Dr. Sato replied that any investment requires a business case. Simulation, like any technology, is a tool that must be used to achieve a specific objective. CRICO/RMF's objective, for example, was to reduce claims in certain high-risk areas, i.e., anesthesiology and obstetrics.

Asked about the adverse outcome index used by CRICO/RMF to rank adverse outcomes in obstetrics, Dr. Sato explained that it could take at least three years from an adverse event to a malpractice claim and a number of additional years to determine the outcome of the claim. Therefore, malpractice claims are an unreliable source of information on the frequency of adverse events. The index was developed as a proxy for identifying ways to reduce malpractice claims. Dr. Olympio noted that simulation was only one component of the training and wondered whether CRICO/RMF could determine which components of the training were most effective. Dr. Sato explained that they plan to identify which elements need to be emphasized in the future.

Dr. Dawson wondered how to generalize the results from anesthesiology and obstetrics to other specialties. Perhaps such efforts should begin with analyses that identify areas to address within certain specialties.

An unidentified participant from the Northwest Physicians Insurance Company said that obstetrics practitioners in 17 of its hospitals were eager to have lower premiums or fewer malpractice cases against them. The insurer offered to facilitate the development of elements that would help them achieve this goal. Simulation was one of the elements, and the company took a leadership role in helping implement simulation without a premium change. Perhaps the use of simulation will become standard within the insurance industry. Dr. Sato said that his board of directors was generous in moving ahead with certain incentives.

Ross Horley of Medic Vision, reported that he sits on a state government's insurance company, which is about to introduce a premium allocation model that will impose a small amount of risk on each hospital. This is a carrot-and-stick approach. Dr. Sato explained that in the past, CRICO/RMF focused more on the carrot than the stick because it is difficult to be a policeman and defend physicians. However, the institutions encouraged the company to offer a stick approach because of rising premiums. In general, incentives are effective in changing behavior.

Congressional Interest in Medical Simulation

Honorable J. Randy Forbes, Commonwealth of Virginia; Chair, Congressional Modeling and Simulation Caucus

Congressman Forbes thanked Jackie Eder-Van Hook, CT&L, and AIMS for their invitation to speak about medical simulation and thanked participants for all they are doing in building and promoting medical simulation. He noted that the simulation and modeling field is associated with major economic benefits; for example, the average annual salary in this industry is close to \$60,000. In addition to its economic benefits, the simulation and modeling industry can contribute to national security. Just as modeling and simulation are used in construction and training war fighters, they should also be used for clinicians.

Congressman Forbes meets frequently with CEOs across the country to talk about simulation and modeling. About one-third are very excited about it, one-third do not know what it is, and one-third are familiar with it, but do not understand its applicability to them. Supporters of simulation and modeling need to educate the public about the potential of this field.

Congressman Forbes believes that simulation and modeling are the best way to prepare our country for the challenges in providing medical care presented by the situations in Iraq, Afghanistan, and other countries, as well as the threats posed by natural disasters and avian flu.

In today's world, "jointness" is needed. However, between agencies and health care providers, jointness will not be possible without effective simulation and modeling. One of the most important things that can be done is to develop an architecture so that the entire industry, not just medical simulation, can grow. This industry is not a zero-sum game and many potential competitors need to work together to achieve the common goal.

Congressman Forbes believes that only experts in the field, including academics and industry representatives, can develop simulation and modeling in the right way. Experts should not sit back with all of their information without trying to raise awareness across the country of modeling and simulation. The national security of this country depends on raising this awareness.

Congress and the public know nothing about simulation and modeling. To capture their interest, it is necessary to provide images and videos of what simulation and modeling are and can do. Once Congress understands the potential of simulation and modeling, they will say that more simulation, is needed.

In a recent meeting with President Bush, Congressman Forbes described how simulation and modeling could help attract more students to math and science fields. After NASA, simulation and modeling are the top incentives for drawing students to these critical disciplines.

It is important to identify the needs of potential simulation and modeling customers and then develop technology that will meet these needs. Developers also need to address interoperability. The field is not limited by what is available today—the possibilities are endless.

Simulation and modeling can help the military and health care providers train people to operate in crisis situations without actually experiencing those situations or putting them at risk. For example, simulation and modeling can be used to plan for avian flu. Simulation and modeling can help people avoid errors and prepare for a broad range of catastrophes, including bioterrorism and hurricanes.

If simulation and modeling were used throughout health care, Congressman Forbes believes that litigation costs would drop substantially. The money saved could be used for many important priorities, such as health care prevention.

Discussion

A participant asked about the possibility of jointness among defense agencies, many of which operate as stovepipes. Congressman Forbes noted that a few years ago, some of the stove piping in simulation and modeling was driven by vendors and contractors. They were concerned that if they lost any ground, others would benefit. The message given to everyone is that this will not be allowed to happen because this industry is too important. In every speech Congressman Forbes gives, he emphasizes the need to get the job done with an increased focus on modeling and simulation. He believes that the voices in favor of stove piping are becoming weaker, and groups like AIMS are showing how synergy can advance the field.

Ms. Kigin asked how the attendees could come together to help the government use simulation to prepare for a national emergency. Congressman Forbes emphasized the need to communicate about the major potential benefits of simulation and modeling to policymakers. Attendees need to determine how to communicate this message to Congress and other policymakers, because groups like this one can make an enormous difference.

Congressman Forbes urged participants to share their ideas with his staff for discussion and consideration within the congressional modeling and simulation caucus. He thanked participants and again encouraged them to get involved, talk to their policymakers, and educate them.

2006 AIMS Industry Council Update

Lucas Huang, **B-Line Medical**

John Eggert, **Gaumard Scientific**

Fiona Slevin, **Haptica**

Kim Alfonso, **Immersion Medical**

Lindsay Smith, **Limbs and Things**

Gerry Higgins, PhD, **Laerdal**

Dave Wilson, **Medical Simulation Corporation**

Ross Horley, **Medic Vision**

David Hananel, **METI**

Yael Friedman, PhD, **Simbionix**

Beth Sanchez, **SimMedical**

Bob Waddington, **SimQuest**

Doug Beighle, **Simulab Corporation**

Carol Lake, **Verefi Technologies, Inc.**

Ms. Eder-Van Hook thanked the AIMS Industry Council. She cited their collaboration, commitment to making the industry as a whole successful, and, ultimately, for improving clinical training that will lead to safer and more effective patient care.

Fiona Slevin, chair of the AIMS Industry Council, said that the council members appreciate the opportunity to be an integral part of AIMS. The medical simulation industry is small and varied and the companies in this field have different business models, technologies, customers, products, and perspectives. This session was designed to highlight some of those differences and to show how the Industry Council members have come together with a commitment to a common goal: to harness their collective experience, technologies, and ambitions to improve patient safety through optimum products and services and accelerate growth of this market. The Industry Council works toward this goal by driving standards in design and development; partnering with customers, policymakers, and other interested parties to grow the market; driving for increased funding; and supporting the establishment of standards for proficiency and accreditation.

Ms. Slevin noted that the Industry Council felt it was important to understand better the perceptions, needs, and interests of those in the medical simulation community and to that end, they created a survey and asked 2006 AIMS meeting registrants to respond.

Dr. Higgins described the market for simulation as follows: If the market for medical simulation and modeling is worth \$100 million, which is an assumption, virtual reality and haptics account for about \$25 million, self-directed learning and simulators that involve software only represent \$12.5 million, and the remaining \$62.5 million represents patient simulation, primarily using computer-based mannequins. This is a relatively small marketplace and virtual reality and haptics have probably achieved their potential market strength. A great deal more growth, however, is possible in gaming and self-directed learning for training in certain procedures or mass responses. A little more refinement is possible in the patient simulation portion of this market.

Kim Alfonso reported on the results of a survey of meeting attendees. The survey was sent the week before the meeting to the 2006 AIMS conference registrants. At the time of the meeting, the Industry Council had received 25 responses. Of these respondents, 76% were educators, 52% were decision makers, and 28% were influencers. Almost half spent more than \$100,000 on medical simulation last year, and 27% spent less than \$35,000; 60% intend to spend more than \$100,000 in the coming year. In addition, 71% purchased mannequins, 50% funded development, and 25% purchased laparoscopy/endoscopy simulators. If respondents had more money and could make a better case for the value of simulators, most would spend more on simulation. Approximately, 30% said that they would spend more if the simulators in the market were better.

Overall, the major strengths of the simulation industry were identified as the technology and products. Respondents regard the products as generally good and becoming more lifelike and industry's commitment to quality improvement and collaboration. As demand for simulators increases, costs are continuously coming down.

Some of the weaknesses identified were the quality of simulators and need for validation. Respondents also said that products are not sufficiently robust and are released too early. In addition, product improvement is too slow and timid, and low-fidelity simulators dominate the market. Development costs appear to be prohibitive and products are too expensive. Respondents said that companies do not take the needs of users into account and they promote themselves over the good of the industry. According to the survey, territorial issues are prevalent, and many companies are unwilling to share their software with others.

Respondents said that in the next three years, industry should introduce new simulators and features, including fully functioning procedure-specific, computer-based gaming features, as well as a broader range of simulators and a standard platform. To improve quality, companies need to improve the fidelity, robustness, and educational value of their products and to make these products easier to use.

Ms. Slevin summarized the findings by noting that respondents want more and better simulators at a lower cost for a market with high expectations and a limited budget.

Discussion

Dr. Hunt is distressed at the slow rate at which features are added to simulators on which objective data can be collected. Different simulators have different valuable features, but no single product has all of these features. She wondered whether companies are planning to add additional components that can be measured. Dr. Friedman replied that Simbionix products allow users to measure everything that can be measured by computer. However, some measurements are not valid for performance assessment. Mr. Huang said that several B-Line Medical clients are asking the same question. Manufacturers are willing to make changes to accommodate user needs, but they do not know which features are the most important.

Dr. Higgins reported that Laerdal follows the formal guidelines developed by the Department of Defense (DoD) for task analysis. Mannequins only have a certain amount of space that can be used for technology, so a cost-benefit analysis is needed. The company hopes that it is providing the features that users desire the most, but it might need to leave out a feature that one user wants. Laerdal tries to maintain close relationships with professional societies and groups focused on cutting-edge technologies for education and training. Dr. Hunt wondered whether she should work with her society to advocate for features with simulator manufacturers. Dr. Higgins said he thought that might not be necessary, his company, like others on the AIMS Industry Council, collect information from a variety of sources and through various mechanisms, such as user groups.

Pat Molholt, MLS, PhD, of Columbia University, stated that there would be more of an interest in becoming involved in the use of simulation in training, if a single platform were available and if technologies were interoperable. Dr. Higgins said that curricula and learning objectives need to be standardized first before the technology could be standardized. Unfortunately, the market has very few examples of open-source, interoperable platforms. Mr. Huang suggested that users must identify a uniform set of data that they want collected. Right now, each manufacturer uses what it believes to be the best set of metrics, so audiences must tell companies what they need. No venue currently exists to communicate user needs to manufacturers, but perhaps the meeting attendees could serve in that role.

Greg Schuckman of the University of Central Florida, wondered whether industry is receiving sufficient support from universities in product development. Ms. Alfonso said that universities and physicians are providing companies with a great deal of support and interest. She is very impressed with the quality of their knowledge about simulation. Everything that Immersion Medical produces is tested by physicians, who provide information on the metrics and features they want. Dr. Friedman said that her company collaborates very successfully with universities in developing its products, but it really needs academia to identify standard curricula and metrics. Mr. Huang said that universities serve as advocates for his company, sharing cases, and curricula. The challenge for academic partners is to develop a platform that can be used to share information without raising intellectual property concerns.

Dr. Higgins noted that, to date, NIH has shown very little interest in supporting medical simulation. Most of the federal support for the field has come from the DoD and National Science Foundation. Without federal support for developing a common platform, companies need to back away and build their own models piecemeal to meet current customer needs, which for the industry as a whole is a mistake.

One participant said that academics will never develop standardized curricula, given the broad range of schools. Vendors need to let customers know what types of data can be collected with their products so that users can select the right technology for their needs. A standard platform is needed for exporting information so that universities can use it to determine whether their teaching techniques are effective. Dr. Higgins said that although this can be done, industry would have to deal with hundreds of different entities that want the information provided in different ways. Firewalls, Health Insurance Portability and Accountability Act (HIPAA)

regulations, and other technological issues make it very difficult to share this kind of information electronically.

Ms. Slevin thanked those who responded to the AIMS Industry Council survey and asked all participants who have not already done so to complete the survey. The findings will be shared with the participants and posted to the www.medsim.org website. The Council intends to collect these kinds of data every year to generate additional discussion.

Science and Medical Simulation

Mark Scerbo, PhD, Old Dominion University

Mark Scerbo, PhD, explained that “human factors” is a discipline focused on specifying the capacities and limitations of humans and on designing machines and systems that accommodate these capacities and limitations. Experts in this field apply information on how humans take in information to a wide range of issues, including computer hardware and software, health systems, medical devices, and training systems. The goals of human factors research are to improve the working environment, reduce errors, training requirements, fatigue, stress, and monotony; and increase safety, efficiency, convenience of use, user acceptance, and job satisfaction.

Human factors science has three major objectives: 1) understanding the world around us by describing objects and events and how they fit together, 2) predicting what should happen when we manipulate independent variables, and 3) controlling the world around us.

Dr. Scerbo stated that human factors research could help answer questions in medical simulation. For example, if one wants to find out how much time residents need to practice on simulators to develop expertise, it is necessary to develop an understanding of measurement and expertise in psychomotor skills. That understanding makes it possible to predict which measures to distinguish among levels of expertise. With a good understanding and ability to predict, it is possible to determine how a visual-spatial secondary task can be used to terminate the training phase.

Dr. Scerbo has used human factors theory to redefine simulator proficiency with laparoscopy, which imposes heavy visual-spatial demands on surgeons. According to multiple resource theory, a visual-spatial secondary task that draws on the same attentional resources as laparoscopy should be sensitive to the demands of the surgical task and reflect spare resource capacity. The more difficult the surgical task, the poorer the performance should be on the secondary task. Dr. Scerbo and his colleagues hypothesized that if a visual-spatial secondary task can reflect differences in spare attentional capacity when performed simultaneously with a laparoscopic suturing task, then it should distinguish among surgeons with different levels of skill in laparoscopic suturing.

The investigators tested this hypothesis using four groups: experts who had performed from 100 to 200 basic and advanced laparoscopic procedures and had extensive experience with the simulator, residents who had performed 30 to 100 basic and advanced laparoscopic procedures and were familiar with the simulator; trained novices with no operative experience, but who had

achieved proficiency on the simulator; and novices with no prior laparoscopy or simulator experience. Their primary task was laparoscopic suturing and knot tying on a video trainer simulator. Their performance was measured using a metric that combined time, accuracy, and knot security errors.

Participants also performed a secondary, visual-spatial task alone and simultaneously with the laparoscopic task. A computer screen was placed near the suturing task and participants viewed a sequence of white squares that appeared at random on the right or left side of the display for 300 msec. Performance on this task was measured using the percentage of white squares correctly detected.

The study found that experts and residents did much better on the primary task than residents and novices. Everyone did well at the secondary task when it was his or her only task. However, when the primary and secondary tasks were performed simultaneously, the experts did best, followed by the residents and novices. The preliminary conclusion is that visual-spatial secondary tasks that reflect spare attentional capacity may be distinguishable among levels of expertise in laparoscopic suturing when standard primary task performance measures fail to do so. Furthermore, secondary task measures may provide a more accurate definition of expertise in laparoscopic suturing and offer a better way to set proficiency-based criteria for simulator training.

Without a theoretical rationale, it is not possible to explain the results of a study to test the hypothesis that if Simulator A is better than Simulator B, trainees will acquire skills faster on Simulator A. Every alternative hypothesis is equally plausible. For example, if results show that trainees are faster on Simulator B than Simulator A, it is not clear whether this shows that Simulator B is better.

Medical simulation fits into scientific objectives for understanding, prediction, and control. To improve our basic understanding, simulation can be used to help study treatment processes, practitioner behavior, team/organizational behavior, communication patterns, workload and stressors, error/incident investigation, and alternative medical treatments. Within prediction, simulation can be used to investigate new equipment designs and information technology; test safety interventions and models of disease with interventions; develop and test anthropometric, physiological, and behavioral models of patients likely to be encountered; and test skills training, maintenance criteria, and performance in nontraditional environments. For control objectives, simulation can be used for personnel selection, skill maintenance, organizational drills, error prevention, disease prevention and patient education, and self-management of disease.

Dr. Scerbo concluded his remarks by pointing out that medical simulation holds far too much promise to be relegated solely to training and that simulation will transform the practice of medicine. Key areas for human factors contributions to medical simulation are training paradigms, simulator fidelity, virtual environments, virtual reality, team activities, error reduction, workload, stress, fatigue, haptic perception, multimodal perception, cognitive engineering, methods and techniques, cost justification, validity, control, experimental design, and theory.

“Do or Do Not: There Is No Try”

Richard Satava, MD, FACS, University of Washington

Richard Satava, MD, stated that the desired paradigm of change has not yet occurred and medical simulation is still in its infancy. U.S. medical centers have independent training systems and no standard curriculum exists to serve as a benchmark. Telemedicine and the Internet have not been fully leveraged, in part because of technical issues related to connectivity, personnel, space, and time. No single federal agency is responsible for medical simulation, and no desire for a national consensus exists. As a result, everyone is doing his or her own thing.

Approximately every 100 years, a fundamental revolution occurs in the medical educational process that makes it possible to take a major step forward. Right now, we are in the middle of an incredible revolution and we will not see a comparable revolution for another 100 years. What we do in the next few decades will persist for the next 100 years.

Simulators are only a tool and must be integrated into a comprehensive curriculum. The federal government spends \$8 billion a year on medical education, and 15% of the increase in Medicare and Medicaid funding is used by medical centers that train residents. The federal government must be engaged to participate in allocating this funding with the medical simulation community.

The current message about simulation is that it is only a tool and must be integrated into a comprehensive curriculum. Training and assessment should be used to quantify criteria that reflect levels of proficiency. Only through stringent validation of simulators and their curricula will it be possible to gain acceptance from the training and regulatory bodies.

The lessons learned about simulation in the aviation industry should be transferred to the medical simulation field. For example, the aviation industry learned that what is important is not the simulator, but developing validated curricula. Students must be trained until they meet the criteria established by experts and it is only at that point that they should be permitted to treat patients. Simulators can provide immediate feedback to reinforce learning, so that students have “virtual mentors” that tell them whenever they make an error. Most simulators focus on psychomotor skills, but they need to also assess and give feedback on cognitive skills. Using simulators will allow faculty to spend more time training residents and students.

Dr. Satava listed the requisites for creating a virtual mentor. By tracking the eye of a student who is looking at a monitor, it is possible to identify the salient features at which the student is looking to assess the student’s judgment. Hand motions can be monitored to quantify psychomotor skills during the simulated task. An inference engine can develop algorithms to infer intention from what is observed relative to the motions that result. Student performance can be compared to benchmark performance to provide a real-time critique of the student’s performance.

Dr. Satava offered the following speculations on the future of medical simulation:

- Simulation will become part of medical procedures (through, for example, procedure rehearsal and assessment).
- Training will be continuously assessed.
- Training will be embedded into equipment and devices.
- Procedural rehearsal will precede actual performance.

Dr. Satava supported the use of intelligent tutors to free faculty time and of digital libraries so that the same simulations are not repeated over and over. The government is responsible for helping ensure that curricula are standardized; supporting certification of training centers; funding research in development and validation of simulators, curricula, and new educational models; and providing incentives for business to develop or invest in medical simulation. The medical simulation community needs to take responsibility for ensuring that this occurs. AIMS is on the right track to make that happen.

Closure

Col. Mark Bowyer, MD, USUHS

Gerry Moses, PhD, TATRC

Jackie Eder-Van Hook, MS, CTeL and AIMS

Col. Bowyer thanked the participants for coming to the meeting. He also thanked Ms. Eder-Van Hook, the AIMS organizing committee, and the speakers for a successful meeting. He invited all participants to visit the National Capital Area Simulation Center immediately following the conference. Dr. Moses also thanked Ms. Eder-Van Hook, the AIMS organizing committee, and Dr. Steve Dawson for their tireless efforts.

Ms. Eder-Van Hook closed the meeting by acknowledging the leadership and hard work of Dr. Steve Dawson, Mr. Ferol Vernon, Dr. Gerry Moses, Dr. Mark Bowyer, Dr. Gil Muniz, Dr. Joe Lopreiato, Mr. Bob Waters, Ms. Hilary Hansen, Mr. Brian Rothbart and the many other people involved in the AIMS efforts. Further, she thanked the conference hosts for their support: TATRC, U.S. Army Materiel Command, National Capital Simulation Center of the Uniformed Service University of the Health Sciences, and the Center for Telehealth & E-Health Law along with the conference sponsors, Society of Simulation in Healthcare, Lippincott, Williams & Wilkins, and Gardner Carton & Douglas LLP.

Appendix A – Agenda



MEDICAL SIMULATION'S ROLE IN PROMOTING PATIENT SAFETY

Tuesday, May 16, 2006

Daniel K. Inouye Auditorium, Walter Reed Army Medical Center

7:15-8:00 am - Continental Breakfast

8:00-8:30 am - Welcome and Acknowledgement

8:30-9:15 am - Medical Simulation's Role in Promoting Patient Safety

- Carolyn Clancy, MD, Director, Agency for Healthcare Research & Quality
- James Battles, PhD, Agency for Healthcare Research & Quality

9:15-9:45 am - Intersection of Research and Practical Applications at the NIH

- John Haller, PhD, Director, Division of Applied Science and Technology National Institute of Biomedical Imaging and Bioengineering

10:15-11:15 am - Organized Medicine's Perspectives on Simulation

- Robert Rhodes, MD, American Board of Surgery
- Stephen Clyman, MD, Co-Executive Director, Center for Innovation, National Board of Medical Examiners

11:15 am-12:15 pm - Activating the Medical Simulation Community

- Bob Waters, JD, Gardner Carton & Douglas LLP
- Jackie Eder-Van Hook, Executive Director, Center for Telehealth & E-Health Law and Advanced Initiatives in Medical Simulation

1:00-1:30 pm - Society for Simulation in HealthCare Update

- Dan Raemer, PhD, Partners Healthcare, Chair, Society for Simulation in Healthcare
- David Gaba, MD, Stanford University, Editor, Simulation in Healthcare Journal

1:30-2:00 pm - Risk Management Perspective

- Luke Sato, MD, Chief Medical Officer & Vice President, CRICO/Risk Management Foundation of the Harvard Medical Institutions, Inc.

2:00-2:45 pm - Congressional Interest in Medical Simulation

- Honorable J. Randy Forbes, Commonwealth of VA, Chair, Congressional Modeling & Simulation Caucus

3:00-3:45 pm – AIMS Industry Council Update

- Industry Council Members: B-Line Medical, Gaumard Scientific, Haptica, Immersion Medical, Laerdal, Limbs & Things, Inc., Medical Simulation Corporation, Medic Vision, METI, Symbionix, SimMedical, SimQuest, Simulab Corporation, Verefi Technologies

3:45-4:10 pm - Simulation as the Means to Test the Scientific Basis of Medicine

- Mark Scerbo, PhD, Old Dominion University

4:10-4:25 pm – Do or Do Not There is No Try

- Richard Satava, MD, FACS, University of Washington

4:25-4:30 pm - Closure; Adjourn

5:00-6:30 pm – Reception, National Capital Area Simulation Center

Appendix B – Accomplishments

The efforts undertaken by the Center for Telehealth & E-Health Law to advance medical simulation and leverage the work already performed by the Federal government has been tremendously successful.

- Educated professional licensing boards about the value of medical simulation.
- Provided opportunities for key national leaders to state their interest, declare their intentions, and offer their experiences with regard to medical simulation – one key accomplishment related to this is the public acknowledgement that malpractice claims for simulation-trained clinicians declined over a five-year period based on claims data which resulted in a 35% decrease in premiums for anesthesiologists.
- Informed the military, medical, nursing and allied health communities, academic, and others about the current state of medical simulation.
- Supported the further coalescing of the medical simulation community.
- Articulated the value of medical simulation.
- Showcased the research and commitment of the US Army, TATRC as well as the US Agency for Healthcare Quality and Research, an agency of the Department of Health and Human Services and the National Institute of Biomedical Imaging and Bioengineering, an institute of the National Institutes of Health, an agency of the Department of Health and Human Services.
- Offered a networking opportunity for those interested in advancing the field.